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THE PARADOX OF A LAVA FLOW

By Joseph Wood Krutch

Rippled dunes of volcanic cinders near Sunset Crater.

Since 1930 the National Park Service, U.S. Department of the Interior, has protected Sunset Crater and its story for all to enjoy. Here nature burst forth in a powerful spectacle which profoundly affected the lives of the prehistoric people who lived in the Southwest. The Visitor Center, nature trails, and Park Rangers will help you to relive the past at Sunset Crater and Wupatki National Monuments.

You can help us preserve this place for tomorrow. Take nothing but pictures and leave nothing but footprints.

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Every year streams of tourists on their way to Grand Canyon pass within a few miles of a thousand-foot cinder cone just north of Flagstaff, Arizona. Too few of them turn aside to visit Sunset Crater National Monument and too few of those who do learn anything about one of the strangest paradoxes which archeology has revealed.

For a century or two the region 'round about was occupied by a flourishing, fast growing community. But it was not, as you might imagine, destroyed by the great eruption which covered hundreds of square miles with sand and lava. Instead, it was created by that same lava flow, and thereby hangs the tale.

We know that nations have often risen and fallen as their soil increased or decreased in fertility. This is usually a slow and often obscure process. But here on a small stage and within a very brief span of years a striking drama was played out. Its theme was the dependence of prosperity upon the soil at a people's disposal. And the eruption had temporarily improved that soil.

The story begins at the very end of a recent epoch of intense volcanic activity whose mightiest effort resulted in the building of San Francisco Peaks which are now nearly thirteen thousand feet about sea level, five thousand above the

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Bonita Lava Flow — Sunset Crater National Monument

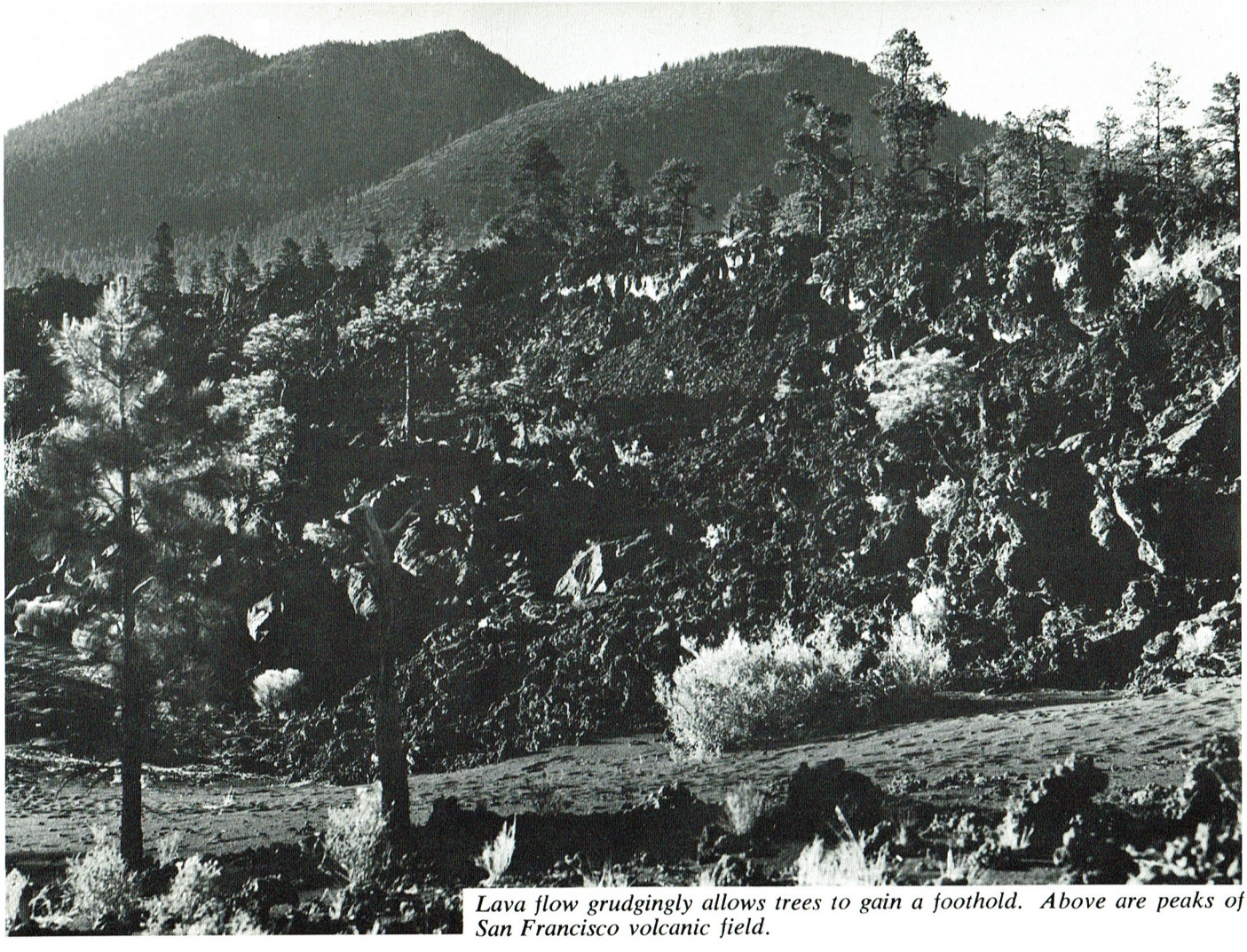
plateau on which they rest and were once at least three thousand higher. These cones must have been built rather recently because they rest upon the same Kaibab limestone which forms the rim of Grand Canyon—which means that the overlying strata must here as at the Canyon have been eroded away before the volcanoes burst forth. Still, the most violent activity certainly occurred before there were any men to witness or be destroyed by it. But the activity subsided gradually over a long period and minor outbreaks occurred from time to time. There are at least two hundred cinder cones built up

later than the San Francisco Peaks and the most recent of all (as well as the most spectacular) is Sunset Crater. When it was created man was already long established in the vicinity.

Visible from the highway, the stark cone is likely to catch the eye of the least observant tourist because it so obviously is what he has imagined a volcano to be. The symmetrical cone, truncated at the top, rises steeply like a gigantic ant hill, its sides the greyish black of cinder and almost completely bare of vegetation. Obviously nature has not had time to reconquer it as she has reconquered San Francisco Peaks. It is an unhealed scar, grimly beautiful but also the mute reminder of a catastrophe which looks as though it might have struck a few years instead of a few centuries ago.

A squeeze-up is seen with a veteran pine, giving up the struggle, standing nearby.

Sunset Crater. Through the lava around its base forests have begun to rise, but much is still bare.



Lava flow grudgingly allows trees to gain a foothold. Above are peaks of San Francisco volcanic field.

Turn off onto the road which leads east a few miles to the base of the cone and the sense that one is in the presence of a recent yesterday grows stronger and stronger. Those who come as we do from the Canyon to the north have been for many miles accustomed to stretches of black desert whose surface is partly covered with lava. But here the road is traversing a bed of clinker-like fragments so jagged and tumbled that it is difficult to walk over them. It is a desolate, nightmarishly beautiful scene of unearthly desolation and of desolation which looks so newly wrecked that one almost expects to see the lava still smoking. Suddenly the road, which has been climbing a rather steep slope, stops at the base of the abruptly rising cone. The rim is stained an angry red which is responsible for the name. In the distance to the east shimmers the Painted Desert. Looking down into the crater, one half expects to see a lake of still boiling lava.

That the catastrophe was not really as recent as one feels it might have been is proved by a few trees which have managed to establish themselves here and there around the cone's base though they sometimes look as though they had just been half buried in the cinders. Actually the eruption (as unusually good evidence proves) took place a little less than a thousand years ago. There were many men present to whom the event was incredible and terrifying enough to be possibly responsible for a still remembered Indian legend.

By comparison with the earlier eruptions in the same general area that of Sunset Crater was a rather small affair. Still, it piled up the cone that is even today a thousand feet high and covered with basaltic sand an area of some eight hundred square miles to a depth which still ranges from more than a foot near the cone to a fraction of an inch at the periphery. Naturally all the vegetation must have been killed over most of this area. And the burned out remains of Indian dwellings plainly overwhelmed by the catastrophe have been excavated.

Weird landscape seen from the crater rim, showing dunes of ash and irregular patterns of trees which have found foothold in the inhospitable soil.

But when the sand and cinder cooled, a surprising phenomenon occurred: the land became temporarily more fertile than before—not because the sand and cinder provided any nourishment but because it acted as a mulch. In desert regions anything which retards the evaporation of the scanty rainfall promotes the growth of plants. One may see the effect today near the base of the cone where vegetation flourishes only where one would, at first thought, suppose it to be impossible —namely, on, or rather under, the foot or more drifts of cinder. Nothing, one would have said, could grow there. But plants, rooted in the soil beneath, have pushed their way up through the cinders to bear flowers and fruit whereas a few

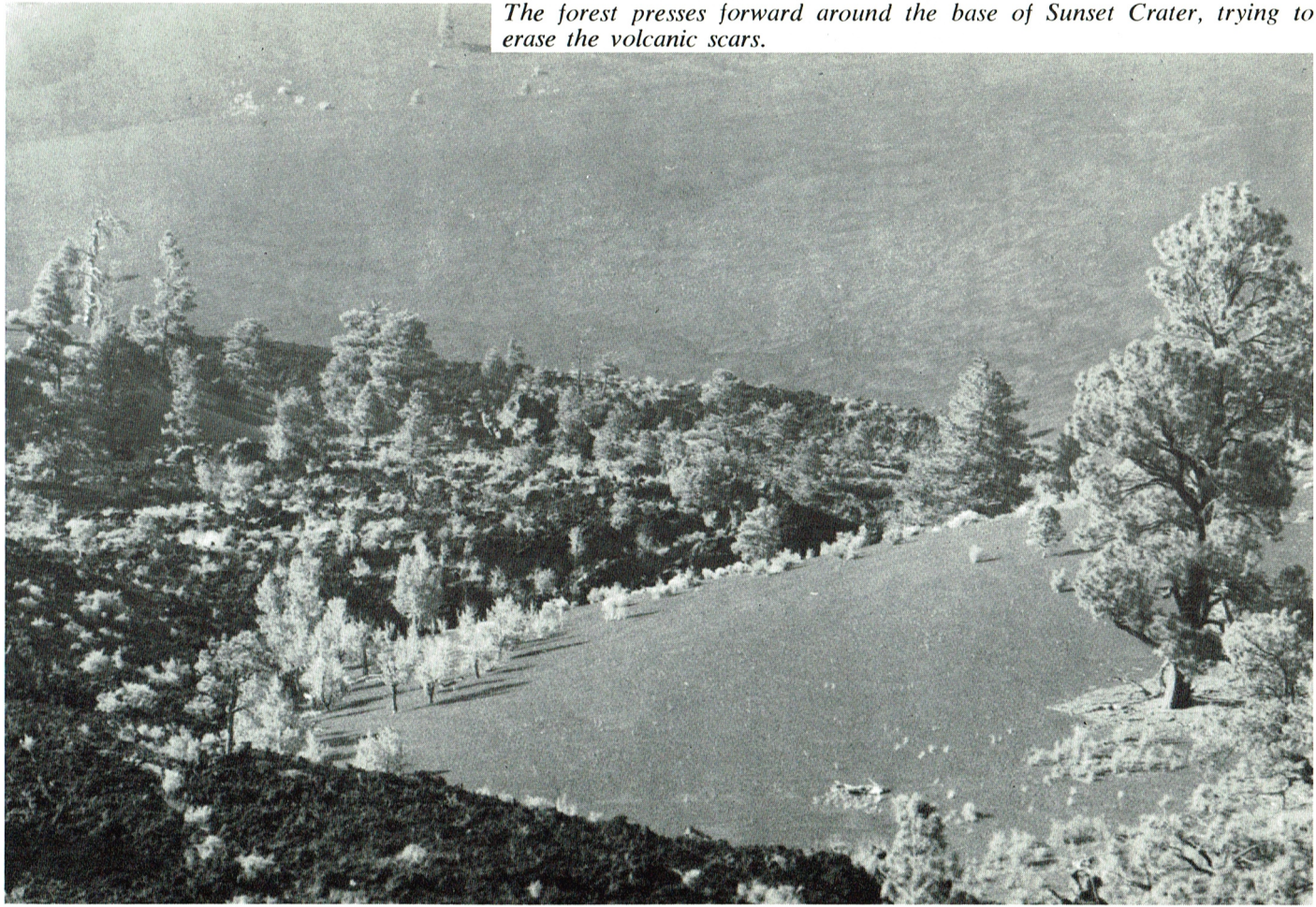
View from rim of Sunset Crater, looking

ng north over the Painted Desert, Arizona.

feet away the ground is parched and dead. Present day desert dwellers notice the same phenomenon when weeds and wildflowers elsewhere absent come up in the gravel covered areas of their patios. On a grander scale it is exhibited also on the slopes of San Francisco Peaks. Only the summits of all the mountains round about are crowned with juniper and pine because only at higher elevations is there enough rainfall to support them. But the better a given area is mulched with cinder the less rainfall is necessary and the forests follow the cinders downward. Northward and southward the lower limit of pine follows the 7,000-foot contour line. Where the cinder covering is deep the lower limit drops a thousand feet. Moreover, the growth rings of the cinder-mulched trees are wide, thus indicating abundant moisture.

The Hopi Indians, who now live on mesa tops some miles to the east and grow corn on the sandy desert, still take advantage of the phenomenon. They dig a hole in the sand sometimes as much as eighteen inches deep and at the bottom of it they plant their seed corn. Any farmer of a kindlier land would tell them it would never come up. But it does. Rooted in the moist soil beneath the sand it pushes through and though never very high above the surface it ripens the grain which supports the tribe and has done so for so many hundreds of years that one of the Hopi villages is known to have been continuously inhabited for a longer time than (so far as known) any other community within the United States. Lines of heavy stones placed at strategic spots anchor the sand and prevent it from blowing away or piling into drifts. Some Indian community—composed possibly of the Hopi's ancestors—understood the value of a cinder mulch shortly after the time of the Sunset eruption and they took advantage of it.

About 1916 Dr. Harold S. Colton of the Museum of Northern Arizona at Flagstaff began an archeological survey of the region which has continued ever since. A certain relatively small number of the ancient dwellings lay beneath the cinder layer and their charred timbers testified to a fiery destruction.



The forest presses forward around the base of Sunset Crater, trying to erase the volcanic scars.

Artifacts (especially pottery) found in both the buried sites and in some of the dwellings built on top of the cinder covering revealed that both had been inhabited during that stage of culture sometimes known as Pueblo II which originated about 900 A.D. and flourished for several hundred years until it was succeeded by that of the great cliff dwellings like Mesa Verde in Colorado. But Prof. A.E. Douglass' tree ring scale made it possible to be much more precise than that. Prof. Douglass concluded that the eruption must have occurred between 875 and 1276. Subsequent further investigation, including coordination of the tree ring data with the evidence of the then rapidly changing pottery styles, has led Dr. Colton to narrow the gap and to place it as after 1046 and before 1071. Tree ring data studied by Terah Smiley of the University of Arizona from roof beams used in the construction of the Wupatki pueblo now indicate that the eruption of Sunset Crater probably took place between the fall of A.D. 1064 and the spring of 1065. In other words this Indian community was destroyed about the time William the Conqueror set sail for England.

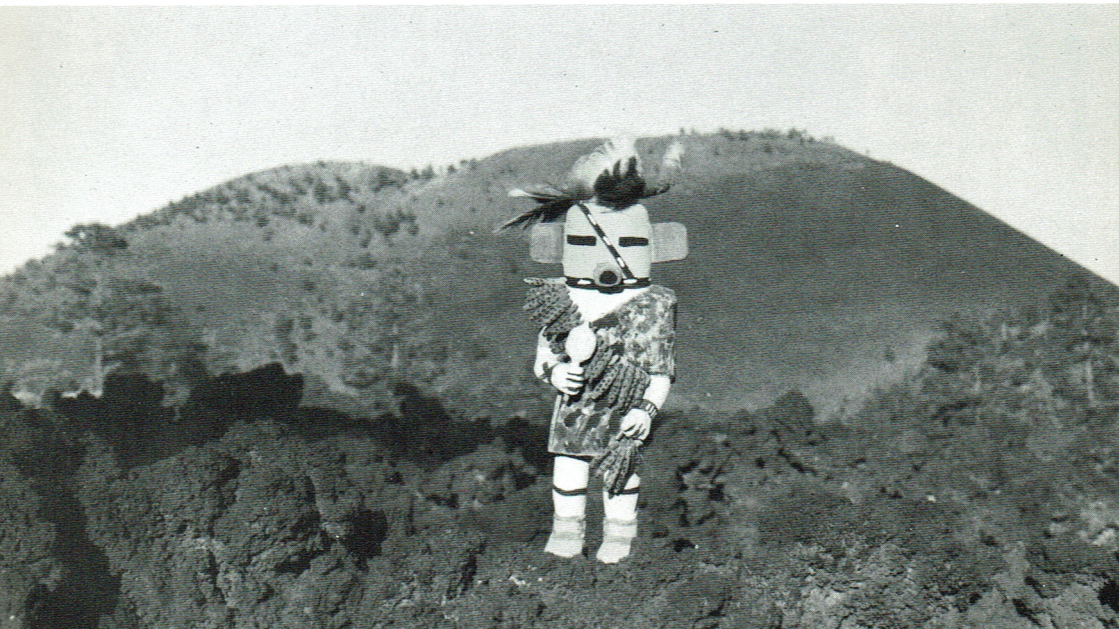
But the most striking paradox is that which the secret of the mulching effect of volcanic sand and cinder enables us to understand. Dwellings built on top of the cinders (and hence subsequent to the eruption) are far more numerous than those prior to it. The catastrophe was also a blessing, very much disguised. The people who moved back into the area, after it had cooled, prospered greatly. Their dwellings also can be dated and for perhaps two hundred years they enjoyed the benefits of unusually fertile land. Then the prevailing west winds piled the volcanic sand into drifts too deep for cultivation while it laid surrounding areas bare. That the inhabitants knew what was happening is evident from the lines of stone, still visible, which anxious cultivators had laid down in an effort to anchor the mulch. But it was a losing battle and in the early 1200's the area was abandoned.

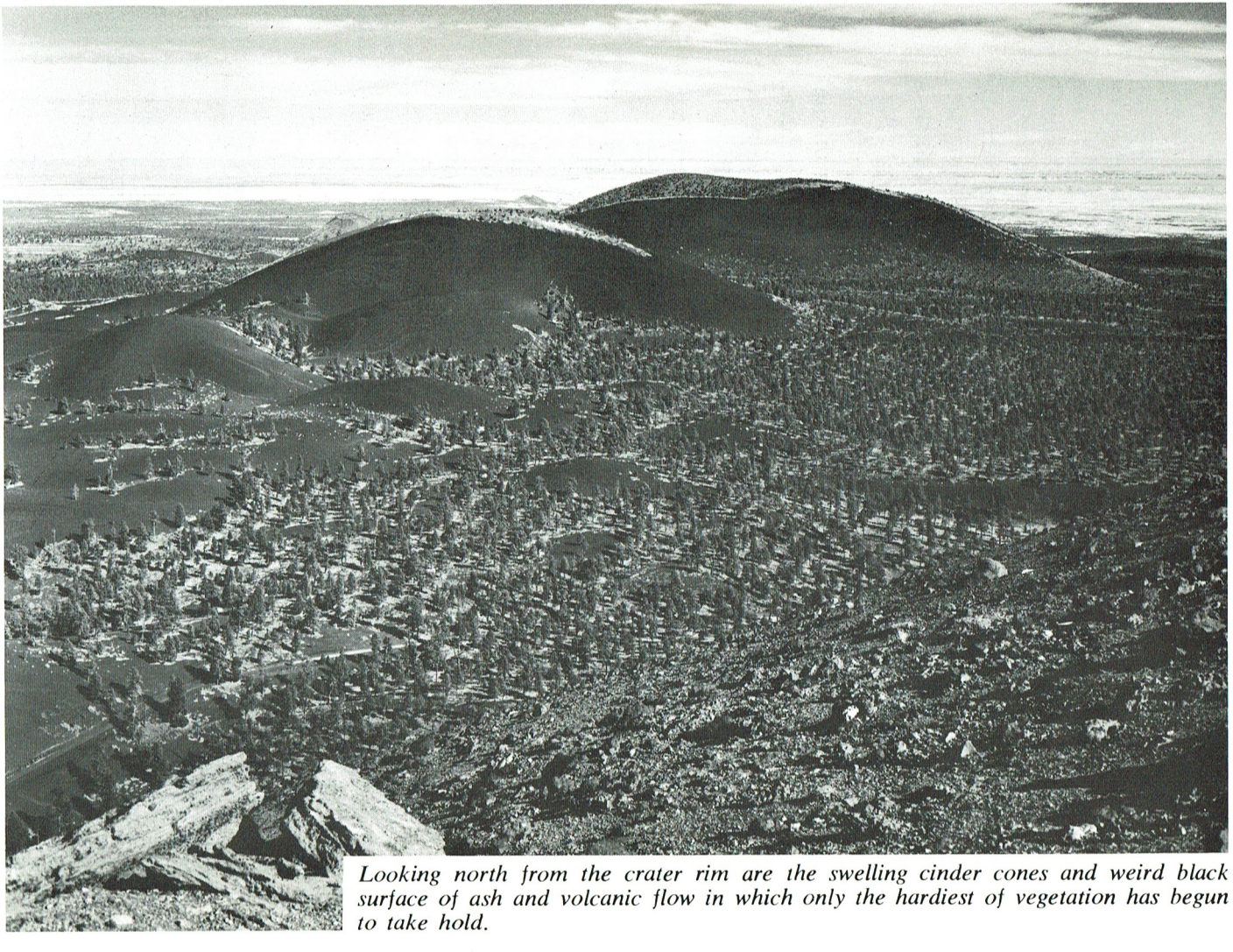
What happened to the vanished population? Did it simply

die out as conditions became impossibly hard or did survivors move elsewhere? There are no certain facts which will answer that question. But where archeology stops anthropology supplies a basis for fascinating and not unreasonable speculation.

Those Hopis who were already in Coronado's time living on their still rather inaccessible mesas to the east are an unusual and interesting people. They are serene, conservative and peaceful though so fiercely independent that in 1680 they expelled the Spaniards after killing their missionaries. And unlike some of the other Pueblo dwelling peoples most of them have never since either accepted Christianity or much changed their way of life! They still farm by the ancient methods, make pottery and practice the elaborate religious rites which are an important part of a close communal life. Their gods are the kachinas and for the education as well as the amusement of their children they make those kachina dolls of which cheap imitations are widely sold in curio shops throughout the Southwest. But an odd feature of their religion is this. The home of the gods is not in the region where they live but on San Francisco Peaks which dominate the landscape near the

Kana-á, the Hopi kachina, who according to ancient legend, lives in Sunset Crater.





Looking north from the crater rim are the swelling cinder cones and weird black surface of ash and volcanic flow in which only the hardiest of vegetation has begun to take hold.

now deserted area around Sunset Crater. The Hopis still make pilgrimages to the peaks for religious reasons.

Notoriously, religion is the most conservative part of most cultures. We ourselves still tend to build our churches in an ancient architectural style. Similarly many Pueblo dwelling groups conduct their religious ceremonies in *kivas* which appear to be modeled on the ancient pit houses which were the usual kind of dwelling house before the above-ground pueblos were developed. Does the fact that the Hopis' sacred mountain is so far away from their present home suggest that they once lived near that sacred mountain? Did they migrate from the once favorable but now no longer cultivatable area of the Sunset Crater lava field taking their religion and their agriculture with them but leaving their gods where they had always been?

Among the Hopi legends there is, in any event, one which tells of a destruction of the wicked by fire. In a certain village, so the legend runs, a good chief was disturbed by the degeneracy of his people—especially by the fact that even the women would join in the gambling games to which the whole tribe was disastrously addicted. One night he noticed light in the mountains. He told his people about it but they ridiculed him and went on with their games. During four successive nights the light grew brighter and the fire began to spread out toward the village. But the gamblers refused to heed the warning and ridiculed the chief whom they accused of trying to frighten them away from their games. Finally, too late for most, they realized the danger and were either suffocated or burned to death. Only a few were saved.

This seems pretty clearly a memory of some volcanic eruption though there is no evidence of any recent one near where the Hopis now live. Perhaps—but of course only perhaps—it goes back to Sunset Crater and the flight of the original inhabitants some of whose descendants later returned only to abandon the region again when the wind had made it unfertile once more.

Squeeze-ups. Lava, pushing up through an already hardening surface of lava, came out in wave-like extrusions, frozen by sudden contact with air.

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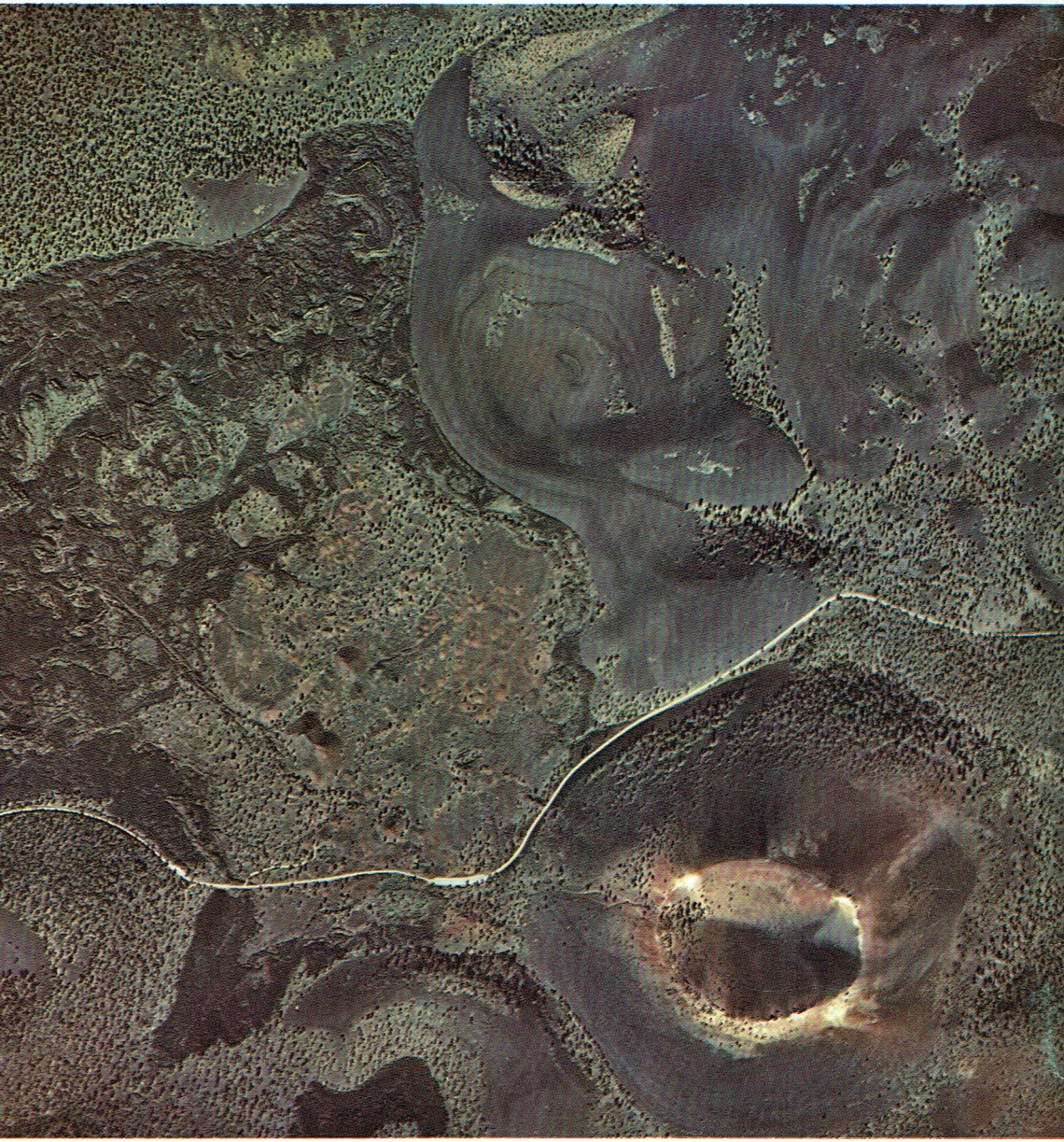
1st Printing 1974
10,000 copies